BETTIS ACTUATOR & CONTROLS

SERVICE INSTRUCTIONS

FIELD CONVERSION OF SPRING

CARTRIDGE FAIL DIRECTION

CLOCKWISE TO COUNTER-CLOCKWISE

OR THE INVERSE

FOR THE FOLLOWING SERIES

T3XX-SRX AND T4XX-SRX

SPRING RETURN ACTUATORS

PART NUMBER: SERVICE-088

REVISION: "A"

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1.0 INTRODUCTION

1.1 This service procedure is offered as a guide to change the fail direction on Bettis T3XX-SRX, T3XX-SRX-M3, T3XX-SRX-M3HW, T4XX-SRX, T4XX-SRX-M3, and T4XX-SRX-M3HW series actuators. When the actuator model number has "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

1.2 This procedure is written with the understanding that the actuator has been removed from the valve, the air or power gas has been removed from the power cylinders and all piping and accessories mounted on the actuator have been removed.

NOTE: It may not be necessary to remove those accessories that are mounted on the actuator housing. If the actuator remains on the valve actuator spring pre-load may not be removed. The pre-load will have to be removed by removing the mounting hardware between the actuator and actuator mounting bracket or by pulling the key between the valve and the actuator yoke.

1.3 SAFETY STATEMENT: Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by a well trained, equipped, prepared and competent technician.

WARNING: For the protection of personnel working on Bettis Actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the Warnings, Cautions and Notes contained in this procedure.

1.3 **DEFINITIONS:**

WARNING: If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.

CAUTION: If not observed, user may incur damage to actuator and/or injury to personnel.

NOTE: Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.

2.0 SUPPORT ITEMS AND TOOLS

2.1 Support Items - Four in number 7/8 inch 9 UNC hex nuts and non-hardening thread sealant.

2.2 TOOLS - All tools are American Standard inch. Two each medium screwdriver, strap wrench, Allen wrench set, 1/2" drive socket wrench set, rubber or leather mallet, 1-7/16" deepwell socket, 1-5/16" box end wrench, and torque wrench (up to 100 foot pounds).

3.0 REFERENCE BETTIS MATERIALS

3.1 Assembly Drawing 036040 for T3XX-SRX(CW)-M3/HW failing close actuators.
3.2 Assembly Drawing 048025 for T3XX-SRX(CCW)-M3/HW failing open actuators.
3.3 Exploded Detail Drawing 063406 for T3XX-SRX actuators.
3.4 Exploded Detail Drawing 065598 for T3XX-SRX-M3/HW actuators.
3.5 Assembly Drawing 035730 for T4XX-SRX(CW)-M3/HW failing close actuators.
3.6 Assembly Drawing 048027 for T4XX-SRX(CCW)-M3/HW failing open actuators.
3.7 Exploded Detail Drawing 063409 for T4XX-SRX actuators.
3.8 Exploded Detail Drawing 065599 for T4XX-SRX-M3/HW actuators.

4.0 GENERAL

4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.

4.2 Numbers in parentheses, ( ) indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawing, and Actuator Parts Lists.

4.3 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front of the actuator. The housing cover (1-20) will be the top of the actuator.

4.4 Refer to Chart 1 of this instruction for approximate actuator weights.

4.5 Use a non-hardening thread sealant on all pipe threads.

CAUTION: Apply the thread sealant per the manufacture's instructions.

5.0 GENERAL DISASSEMBLY

5.1 If an M3 Jackscrew is mounted in the power cylinder (2-10), the M3 (2-210) should not contact the end of the piston rod (2-170).

5.2 Remove the socket cap screws (1-180) from position indicator (1-170) yoke weather cover (3-130) and remove position indicator/yoke weather cover.

6.0 SPRING CARTRIDGE REMOVAL

WARNING: Under no circumstances should the spring cartridge be cut apart, as the spring is pre-loaded and the spring cartridge welded together.

WARNING: When the spring cartridge is installed on the actuator the spring is under compression. Do not remove the spring cartridge until the actuator has the stop screw "pre-load" removed.

6.1 Remove spring cartridge stop screw "pre-load" as follows: Apply nominal operating pressure to the pressure inlet port located in the outer end cap (2-30). Locate the stop screw (1-60) that is on the opposite side of the housing from the spring cartridge (4-10). Loosen jam nut (1-120). Unscrew and remove stop screw (1-60). Remove pressure from the pressure inlet port.

6.2 Remove socket head screw (4-60), lockwasher (4-50) and nut retainer (4-40) from the end of the spring cartridge assembly (4-10).

6.3 Alternately loosen the two large hex nuts on the outboard end of the spring cartridge (4-10). These nuts are welded to the tie bars that extend through the spring cartridge and screw into the actuator housing (1-10). Unscrew the tie bars until the spring cartridge, including loose spacer plate, is free from the housing. Care should be taken so that the tie bars are not pulled back into the spring cartridge.

6.4 To keep from inadvertently pulling the tie bars back into the spring cartridge use 7/8 inch 9 UNC hex nuts and screw them on to the spring cartridge tie bars. Place the spring cartridge to one side.

7.0 PRESSURE CYLINDER REMOVAL

7.1 Remove breather (4-30) from inner end cap (2-40).

7.2 Stroke the actuator to it's mid stroke position (45° degrees) as follows:

7.2.1 Actuators without M3 or M3HW - Apply ten psig pneumatic pressure to the inlet port located on the outer end cap (2-30). When mid position is achieved then remove the pneumatic pressure from the outer end cap.

7.2,2 Actuators equipped with M3 or M3HW - Loosen and rotate the nut (2-130) all the way back to the retaining nut. Rotate the M3 clockwise until the mid stroke position (45° degrees) is achieved. Rotate the M3 stud counter-clockwise until the M3 stud is no longer in contact with the piston rod.

7.3 Remove cover screws (1-90) with gasket seals (3-100).

7.4 NOTE: The housing cover will have a very tight fit. Remove the housing cover (1-20).

7.5 Unscrew push rod (4-20) from yoke pin nut (1-30) and remove from housing (1-10).

CAUTION: Care should be taken not to mar the piston rod (2-170) in the area that passes through the rod bushing (2-50) and the rod seal (3-70).

7.6 Unscrew piston rod (2-170) from yoke pin nut (1-30) by using a wrench (pipe, strap or vice grip wrench) that will allow the piston rod to be gripped as close to the yoke pin nut (1-30) as possible.

7.7 NON M3 EQUIPPED ACTUATORS - Unscrew and remove socket head cap screw (2-120), lockwasher (2-110), and nut retainer (2-100).

7.8 M3 EQUIPPED ACTUATORS - Loosen and remove socket cap screws (2-200) from jackscrew adapter (2-190). Back jackscrew adapter (2-190) out until clear of hex nuts (2-90).

7.9 NOTE: Do not remove the nuts from the tie bars. Back off both tie bar hex nuts (2-90) until they are finger loose.

CAUTION: Cylinder (2-10) should be supported during removal.

7.10 With the tie bar nuts (2-90) hand tight against the outer end cap (2-30), the tie bars (2-60) will protrude through the nuts (2-90) far enough to allow a wrench to be placed on the flats at the outboard end of the tie bars. Alternately back the tie bars out at approximately one turn per tie bar, making sure that the cylinder package follows the tie bars as they are unscrewed from the housing (1-10).

7.11 When the tie bars (2-60) are completely unscrewed from the body, grasp the inner end cap (2-40) and pull the entire cylinder package away from the housing (1-10). Place two tie bar nuts on the exposed tie bar ends and tighten them hand tight against the inner end cap (2-40).

8.0 PRESSURE CYLINDER REINSTALLATION

NOTE: Back out the stop screw (1-60), which was not loosened previously, and screw it out until there is no possibility of the yoke coming into contact with the stop screw and creating a pre-load condition when the spring cartridge is installed.

8.1 If the rod bushing did not stay on the piston rod (2-170) when the cylinder package was removed from the actuator then remove the rod bushing. Reinstall the rod bushing to the side of the housing (1-10) that will be the new location of the power cylinder.

8.2 Install the push rod (4-20) into the side of the housing, where the new location of the spring cartridge will be, and screw into the yoke pin nut (1-30). Tighten the push rod with a strap wrench.

8.3 If the end cap gasket (3-10) was damaged then install a new end cap gasket (3-10) over the piston rod and rod bushing and up against the housing.

CAUTION: If the cycle speed of the actuator is two seconds or faster, apply Loctite 242 to the external threads of the piston rod (2-170). NOTE: Loctite cure time is 10 - 30 minutes.

8.4 NOTE: When tightening the piston rod into the yoke pin nut (1-30) care should be taken not to mar the piston rod in the area that passes through the rod bushing (2-50) and the rod seal (3-70). Install the power cylinder package into it's new location by inserting the piston rod (2-170) through the rod bushing, installed at step 8.2, and screwing piston rod into the yoke pin nut. Tighten the piston rod.

8.5 Manually push the cylinder package toward the housing (1-10) until there is just barely enough room left between the ends of the tie bars and the housing to remove the nuts installed at step 7.11.

8.6 By pressing on the ends of the tie bars, slide the cylinder package against the housing (1-10) until the tie bars engage the housing threads.

8.7 Using the flats on the ends of the tie bars alternately tighten the tie bars one or two turns per tie bar until the cylinder package is against the housing. Back off the tie bar nuts (2-90) so that the tie bars can be seated with the flats. Tighten the tie bars until the threads bottom out, then back out a half-turn.

NOTE: It is necessary that the flats on the hex nuts (2-90) be aligned and parallel before the nut retainer or M3 adapter can be installed.

8.8 While the nuts are being tightened, do not allow the tie bars to turn. Torque alternately, in 50 foot pounds increments, until a final torque of 65 ±7 foot pounds has been achieved.

8.9 ON NON M3 EQUIPPED ACTUATORS - Install nut retainer (2-100), securing in place with retainer screw (2-120) and lockwasher (2-110).

8.10 ON M3 EQUIPPED ACTUATORS - Insert jackscrew adapter (2-190) and jackscrew assembly (2-210) back into the outer end cap.

8.11 Retain the jackscrew adapter (2-190) with socket head cap screws (2-200).

8.12 Rotate the jackscrew assembly counter-clockwise until end of CCW travel, thread seal nut (2-130) down to the M3 adapter and tighten.

9.0 SPRING CARTRIDGE REINSTALLATION

9.1 Make sure that stop screws (1-60) have not been screwed into the point that "pre-load" will be created on the spring cartridge.

9.2 Install end cap gasket (3-10) over push rod (4-20).

9.3 Prepare SR cartridge (4-10) to be installed as follows: Remove the safety nuts, loose spacer plate, and gasket (4-70). If needed install replacement gasket over the tie bars, then install loose spacer plate over the tie bars.

9.4 Install SR cartridge (4-10) onto push rod (4-20). Do not allow the tie bars to be pushed back into the SR cartridge. Insert the tie bars through gasket (3-10) and into the matching holes in housing (1-10).

9.5 Screw the tie bars into housing (1-10). Alternately tighten each until the SR cartridge is firmly attached to the housing.

9.6 NOTE: It is necessary that the flats on the tie bar hex nuts be aligned and parallel before the nut retainer can be installed. Tighten each tie bar to 65 ±7 foot pounds. Install the nut retainer (4-40) between the hex heads of tie bars. Retain by tightening screw (4-60) with lockwasher (4-50).

10.0 CENTER HOUSING COVER RE-INSTALLATION

10.1 Steps 10.2 through 10.6 can be skipped if there was no damage to cover gasket (3-20) or o-ring seal (3-50).

10.2 Remove used yoke o-ring seal (3-50) from housing cover (1-20).

10.3 Remove used housing cover gasket (3-20) and clean the housing cover for new gasket

10.4 Place new housing cover gasket (3-20) onto housing (1-10).

10.5 Install new o-ring seal (3-50) into housing cover (1-20).

10.6 Install housing cover (1-10), being careful not to damage gasket (3-20) or yoke o-ring (3-50).

10.7 Install cover screws (1-90) with seal gaskets (3-100). NOTE: Leave screws (1-90) finger tight-do not tighten.

10.8 Do this step only if you have pulled cover pins (1-130) or if you are replacing the cover pins. Drive four pins (1-130) through cover (1-20) and into housing (1-10) until the pin is flush with the cover. The pins are deeply grooved at one end, tapering to a smooth diameter at the other end. The pin should be installed smooth end first.

10.9 Tighten cover screws (1-90).

10.10 POSITION INDICATOR INSTALLATION - See step 10.11 for spring to close actuators (CW) or step 10.12 for spring to open (CCW) actuators.

10.11 For spring to close actuators (clockwise) rotate the yoke to the full clockwise (CW) position (as shown on the clockwise assembly drawings) position the yoke weather cover (3-130) /position indicator (1-170) on the yoke with the pointer facing the front and perpendicular to the piston rod (2-170). Secure with the socket head cap screws (1-180).

11.12 For spring to open actuators (counterclockwise), rotate the yoke to the full counterclockwise (CCW) position (as shown on the counterclockwise assembly drawings), position the yoke weather cover (3-130) position indicator (1-170) on the yoke with the pointer facing the right and parallel with the piston rod (2-170). Secure with the socket head cap screws (1-180).

11.0 RETURN TO SERVICE

11.1 Install breather (4-30) in the inner end cap of the cylinder (2-10).

11.2 For actuators equipped with a M3 jackscrew and require an optional handwheel, M3HW, install the handwheel using the following steps 11.3 through 11.5.

11.3 Place the handwheel (8-10) onto the M3 stud and over the nut (the handwheel hub has a cast hexagon hole that fits over the nut).

11.4 Place lockwasher (8-20) onto M3 up against handwheel hub.

11.5 Place hex nut (8-30) onto M3 and thread up against lockwasher, torque to 250 foot pounds.

11.6 Adjust both stop screws (1-60) per valve manufactures specifications making sure that the actuator does the actual stopping not the valve.

11.7 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).

11.8 Re-install any piping and accessories that were removed.

CHART 1 - ACTUATOR WEIGHTS (1)

ACTUATOR MODEL	APPROXIMATE WEIGHT (POUNDS) (2) SR1	SR2	SR3	SR4	SR5
T310-SRX	489	420	322	329	332
T310-SRX-M3	497	428	330	337	340
T310-SRX-M3HW	503	434	336	343	346
T312-SRX	523	454	356	363	366
T312-SRX-M3	531	462	364	371	374
T312-SRX-M3HW	534	468	370	377	380
T316-SRX	568	499	401	408	---
T316-SRX-M3	576	507	409	416	---
T316-SRX-M3HW	582	513	415	422	---
T410-SRX	524	539	470	372	375
T410-SRX-M3	534	539	480	382	385
T410-SRX-M3HW	540	555	486	388	391
T412-SRX	559	574	505	407	410
T412-SRX-M3	569	584	515	417	420
T412-SRX-M3HW	575	590	521	423	426
T416-SRX	604	619	550	452	455
T416-SRX-M3	614	629	560	462	465
T416-SRX-M3HW	620	635	566	468	471
T420-SRX	670	685	616	518	---
T420-SRX-M3	680	695	626	528	---
T420-SRX-M3HW	686	701	632	534	---

NOTES: (1) Includes both fail clockwise (CW) and fail counter-clockwise (CCW) actuator models.

(2) Weights listed for each actuator model are for bare actuators without accessories or valve mounting brackets.